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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/730,762	12/08/2003	Zhigiang Zhang	AA207/98002	3466

7590 08/22/2006

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EXAMINER

GOLOBOY, JAMES C

ART UNIT	PAPER NUMBER
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1714

DATE MAILED: 08/22/2006

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

10/730,762

Applicant(s)

ZHANG ET AL.

Examiner

James Goloboy

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 12/08/2003.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-61 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☐ Claim(s) _____ is/are allowed.
- 6) ☒ Claim(s) 1-61 is/are rejected.
- 7) ☐ Claim(s) 2,4 and 39 is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☒ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on _____ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some * c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
2. ☐ Certified copies of the priority documents have been received in Application No. _____.
3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).
- * See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08)
Paper No(s)/Mail Date _____.
- 4) ☐ Interview Summary (PTO-413)
Paper No(s)/Mail Date. _____.
- 5) ☐ Notice of Informal Patent Application (PTO-152)
- 6) ☐ Other: _____.

DETAILED ACTION

Specification

1. The abstract of the disclosure is objected to because it is longer than 150 words.

Correction is required. See MPEP § 608.01(b).

2. The disclosure is objected to because of the following informalities: On page 1 line 24 of the specification, "it's" should be "its". On page 9 line 5 of the specification, "surprising" should be "surprisingly". On page 10 line 23 of the specification, "loose" should be "lose".

Appropriate correction is required.

Claim Objections

3. The numbering of claims is not in accordance with 37 CFR 1.126 which requires the original numbering of the claims to be preserved throughout the prosecution. When claims are canceled, the remaining claims must not be renumbered. When new claims are presented, they must be numbered consecutively beginning with the number next following the highest numbered claims previously presented (whether entered or not).

Misnumbered claim 12 been renumbered 11, and misnumbered claims 14-63 have been renumbered 12-61. Hereafter, the claims are referred to by their new numbers.

4. Claim 2 is objected to because of the following informality: "typical aspect ratio of 500-5000" on lines 2-3 is indefinite, since the disclosure does not define "typical". Given that the applicant has quantitatively defined the aspect ratio, it is recommended that the word "typical" be eliminated.

5. Claim 4 is objected to because of the following informality: There is no antecedent basis in Claim 1 for "said dispersant". The term "dispersing agent" is used in Claim 1. Appropriate correction is required.

6. Claim 39 objected to because of the following informality: There is no antecedent basis in Claim 1 for "said polar functional hydrophilic group". It is recommended that the claim be made dependent on Claim 38 rather than Claim 1.

Claim Rejections - 35 USC § 112

7. The following is a quotation of the second paragraph of 35 U.S.C. 112:

The specification shall conclude with one or more claims particularly pointing out and distinctly claiming the subject matter which the applicant regards as his invention.

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8. Claims 2, 4, 5, 9, 11, 12, 26, 28, 29, 54, 57, and 60 are rejected under 35 U.S.C. 112, second paragraph, as being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

- a. Claim 2 recites the limitation "said carbon nanotube" in line 1. There is insufficient antecedent basis for this limitation in the claim. Claim 1 refers to a "carbon nanomaterial", which is not necessarily limited to nanotubes.
- b. Claims 4, 5, and 9 recite the limitation "said liquid medium" in line 2 of Claim 4, line 1 of Claim 5, and line 1 of Claim 9. There is insufficient antecedent basis for this limitation in the claim. Moreover, the definition of "liquid medium" does not appear to be consistent throughout the claims. While the content of Claims 4 and 5 imply that "said liquid medium" is the neat fluid recited in Claim 1, Claim 58 (cited as evidence) refers to the "liquid medium" as the combination of the neat fluid and a dispersant.
- c. Claims 11 and 12 recite the limitation "said fluid", referring to Claim 1. However, two fluids are discussed in Claim 1—the "thermally enhanced fluid composition", and the "neat fluid" that is one of the elements of the composition.
- d. Claims 26, 28, and 29 use improper Markush language. The word "comprising" should be replaced with "consisting". Also, the word "and" should be deleted from line 5 of Claim 26 and line 8 of Claim 27.
- e. Claims 54, 57, and 60 recite the limitation "said dispersed nanomaterial solution". There is no antecedent basis for this limitation in the claims. Also, the use of "fluid composition" in Claims 54, 57, and 60 implies that the "dispersed

nanomaterial solution" referred to is not the fluid composition formed in Claims 53, 56, and 59.

Claim Rejections - 35 USC § 102

9. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

10. Claims 1, 3, 5, 7, 9, 12-16, 18-22, 25-26, 36-37, 45, 49, and 51 are rejected under 35 U.S.C. 102(e) as being anticipated by Bonsignore (U.S. Pat. No. 6,432,320).

Bonsignore discloses in column 2 lines 5-15 a heat transfer medium, which according to column 2 line 48 may be a liquid, containing an additive nanoparticle size powder, which may consist of carbon, and further discloses in column 5 lines 53-55 and column 7 lines 41-44 discloses that a dispersant may be added to the composition, meeting Claim 1.

In column 8 line 14 Bonsignore teaches that water is a suitable fluid heat transfer medium, as recited in claims 9 and 19. Bonsignore also discloses in column 8 line 21 that synthetic oils are a suitable fluid medium, as recited in Claims 5, 18, and 25. Bonsignore further discloses in column 8 line 21 that esters are a suitable fluid, as recited in Claim 26 (Group VI). In column 8 line 17 Bonsignore discloses an alcohol, as

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in Claim 36, and in column 8 line 30 Bonsignore shows ethylene glycol as a fluid, as recited in Claim 37. In column 9 lines 10-11 petroleum derivatives are disclosed as a suitable fluid, including grease as recited in Claim 12.

In column 5 lines 43-44, Bonsignore discloses that the carbon additive power can be graphite, carbon nanotubes, or blends thereof, as recited in Claims 13-14. In column 10 line 13 Bonsignore describes an additive concentration of 3-20% by weight, anticipating Claim 15, and falling squarely within the ranges claimed in Claims 20 and 45, and in column 10 line 14 a concentration of 10% by weight, anticipating the endpoints of Claims 16 and 21. Furthermore, the endpoints of 1% and 3% by weight of nanomaterial in the various ranges disclosed in column 10 of Bonsignore anticipate the 2% endpoint of Claim 22. In column 7 line 25 the use of functionalization agents for the modification of hydrophilic properties of the additive is disclosed, as in Claim 3.

In column 6 line 57-58 Bonsignore teaches the addition of an oxidation inhibitor, as recited in Claim 49, and in column 7 line 54 teaches the addition of an antifoaming agent, as recited in Claim 51.

In column 5 lines 8-11 Bonsignore teaches the use of an anionic surfactant as an additive, particularly for dispersions of carbon nanotubes. In column 5 lines 53-55 the reference discloses that the chemical additives for suspensions of carbon-based powders tend to act as dispersants, meeting claim 7.

11. Claims 23-24 are rejected under 35 U.S.C. 102(e) as being anticipated by Bonsignore in view of the evidence given by Marquis (JOM, December 2005, p. 32-43).

The discussion of Bonsignore in paragraph 10 above is incorporated here by reference. Bonsignore does not quantitatively define the thermal conductivities of the nanotubes. Marquis gives evidence that the thermal conductivity of carbon nanotubes is recognized to be 1800-2000 W/m-K (see Table I). Hence claims 23 and 24 are anticipated. Since the Marquis reference is used only as evidence its publication date is not critical. See MPEP § 2124, 2131.01.

12. Claim 11 is rejected under 35 U.S.C. 102(e) as being anticipated by Bonsignore in view of the evidence given by Moy (U.S. Pat. No. 6,419,717).

Bonsignore discloses a dispersion of carbon nanotubes in a fluid medium, with ranges of nanotube concentrations that anticipate the ranges claimed in the instant application, as discussed in paragraph 9 above. Moy discloses in column 5 lines 34-37 that a 1% by weight suspension of carbon nanotubes, falling within all the ranges claimed in the instant application and also within the 1-99% range disclosed by Bonsignore, has the consistency of a paste. Moreover, an increased concentration of nanomaterial would further increase the viscosity. Therefore, the fluid compositions disclosed by Bonsignore are inherently in the form of a paste or gel, as recited in Claim 11.

13. Claims 1, 4, 6, 38, and 39 are rejected under 35 U.S.C. 102(e) as being anticipated by Withers (U.S. Pat. No. 6,695,974).

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Withers discloses in column 8 lines 11-15 carbon nanoparticles dispersed in a heat transfer fluid, and in column 7 line 31 (Example 3) uses a dispersing agent, Triton X-100, which is soluble in the liquid medium (ethylene glycol) as recited in Claim 4, is a surfactant as recited in Claim 6, contains a lipophilic hydrocarbon group and hydrophilic functional group as in Claim 38, and the hydrophilic group is an ether as recited in Claim 39. The dispersion of carbon nanotubes in a fluid containing a dispersant meets the limitations of Claim 1.

Claim Rejections - 35 USC § 103

14. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

15. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

16. Claims 8, 27-35, 40-44, 46-48, and 52 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bonsignore in view of Papay (U.S. Pat. No. 5,652,201).

The discussion of Bonsignore in paragraph 10 above is incorporated here by reference. The differences between Bonsignore and the present claims are:

- i) While Bonsignore discloses broad classes of fluids suitable as a heat transfer medium (synthetic oils, esters, etc.), he does not provide any teaching as to the preferred species within those classes. This relates to Claims 27-35.
- ii) Similarly, Bonsignore discloses the option of adding a "traditional dispersant" to the composition (column 7 lines 41-44) but does not define any specific dispersants. This relates to Claims 8, 40-44, and 46
- iii) Bonsignore does not disclose a viscosity improver, a pour point depressant, or a seal swelling agent. This relates to Claims 47-48 and 52.

With respect to i), Papay discloses from column 47 line 35 through column 49 line 44, lists of fluids suitable as a base oils in functional fluids that include many of the compounds recited in Claims 27-29 and 31-32. In Example X (column 56 lines 18-20) and other examples, Papay uses polyalphaolefins with a viscosity below 100 centistokes as the neat fluid, as recited in Claim 30. In column 47 line 42 Papay teaches that hydrogenated oils are a suitable fluid, meeting claim 33, as the list of hydrogenated oils has just two components (API Group II and Group III), and Claim 33 claims all of Group III. Hydrogenated oils typically have a viscosity between 2 and 60 Cst at 100 degrees centigrade as in Claim 34, and Papay discloses in columns 53-57 numerous sample compositions where the neat fluid is present in an amount of up to 99%, as recited in Claim 35.

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With respect to ii), Papay discloses in column 27 lines 64-65 the use of a polyisobutenyl succinimide dispersant as in Claim 40, and in columns 17-23 the use of succinate esters and Mannich base derivatives as recited in Claim 41. In column 46 lines 33-45 Papay also shows the addition of several other compounds recited in Claim 40 as viscosity index improvers, and notes that these compounds may also have dispersant activity. In column 53 line 36 (example II), Papay discloses a fluid composition containing 4.82% dispersant, falling within the ranges recited in Claims 42-44, and in columns 8-13 Papay teaches a detergent additive ("component a"), which taken in combination with the dispersant ("component b") constitutes a DI package as in Claims 8 and 46.

With respect to iii), Papay teaches in column 46 lines 31-43 the use of a viscosity improver, including the types listed in Claim 47, and in column 46 lines 14-19 discloses the use of pour point depressants, including some of the types recited in Claim 48. In column 47 lines 14-33 Papay discloses the addition of a seal swelling agent as in Claim 52.

It would have been obvious to one of ordinary skill in the art to include in Bonignore the specific base oils taught by Papay due to their usefulness as heat transfer media, ashless dispersants in order to reduce metal ash deposits, a detergent to prevent contaminant buildup, pour point depressants to improve the low-temperature performance of the fluid, viscosity improvers to obtain a desired viscosity for the fluid, and seal swelling agents to maintain seal performance.

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17. Claims 2 is rejected under 35 U.S.C. 103(a) as being unpatentable over Withers in view of Moy (U.S. Pat. No. 6,419,717).

The discussion of Withers in paragraph 13 above is incorporated here by reference and discloses a composition of single-walled or multi-walled carbon nanotubes in a fluid with a dispersing agent. Withers does not disclose an aspect ratio of 500 to 5000 for his nanotubes, mentioning a ratio greater than 2 in column 2 lines 45-46. Moy, in column 4 line 24, discloses an aspect ratio of 500 for carbon nanotubes dispersed in a lubricant composition, falling within the range recited in Claim 2.

It would have been obvious to one of ordinary skill in the art to include in Withers the aspect ratio disclosed by Moy, as Withers teaches in column 3 lines 57-60 that a larger aspect ratio leads to more enhanced heat transfer.

18. Claim 10 is rejected under 35 U.S.C. 103(a) as being unpatentable over Bonsignore in view of Nikolaev (U.S. PG Pub. No. 2003/0170167).

The discussion of Bonsignore in paragraph 10 above is incorporated here by reference. Bonsignore discloses the option of adding a "traditional dispersant" to the composition (column 7 lines 41-44) but does not define any specific dispersants. Nikolaev discloses in paragraph 31 lines 11-12 the use of Nonidet P-40, a nonylphenoxy poly(ethyleneoxy) ethanol-type surfactant, for the dispersion of carbon nanotubes in an aqueous medium.

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It would have been obvious to one of ordinary skill in the art to include in Bonsignore a nonylphenoxypoly(ethyleneoxy)ethanol-type surfactant as a dispersant in order to disperse carbon nanotubes in an aqueous medium, as taught by Nikolaev.

19. Claim 17 is rejected under 35 U.S.C. 103(a) as being unpatentable over Bonsignore in view of Moy.

The discussion of Bonsignore in paragraph 10 above is incorporated here by reference. Bonsignore discloses several ranges for the weight percent of nanomaterial in his fluid composition, but does not specifically disclose a range of 0.01 to 5%, or either of the endpoints. Bonsignore also does not disclose a paste. Moy discloses in lines 4-5 of the abstract a range of 0.01 to 20% by weight of carbon nanotubes in a lubricant composition, encompassing the range recited in Claim 17.

It would have been obvious to one of ordinary skill in the art to modify the ranges given by Bonsignore to include the lower endpoint taught by Moy, in order to adjust the viscosity of the composition.

20. Claims 53, 56, and 59 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bonsignore in view of Withers.

The discussion of Bonsignore in paragraph 10 above is incorporated here by reference. Bonsignore discloses a fluid composition comprising a neat fluid, carbon nanomaterials, and a dispersing agent, but does not disclose a method for producing such a composition. Withers, in column 7 lines 13-16 (example 1), describes a method

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for ultrasonically dispersing carbon nanotubes in ethylene glycol, and in column 7 line 31 (example 3) discloses that a dispersant may be utilized, thus producing the a thermally enhanced fluid as described in the instant application. In the absence of evidence to the contrary, it is assumed that the order of the addition of the nanotubes and the dispersant to the ethylene glycol is inconsequential. See *In re Gibson*, 39 F.2d 975, 5 USPQ 230 (CCPA 1930).

It would have been obvious to one of ordinary skill in the art to include in Bonsignore the method of producing the composition as taught by Withers, as ultrasonic dispersion is a common method of suspending nanomaterials in fluids.

21. Claims 54-55, 57-58, and 60-61 are rejected under 35 U.S.C. 103(a) as being unpatentable over Bonsignore in view of Withers, and further in view of Tennant (U.S. Pat. No. 6,099,965).

The discussion of Bonsignore in view of Withers in paragraph 19 above is incorporated here by reference. Bonsignore in view of Withers does not include a pre-shearing step. Tennant, in column 27 lines 29-34, discloses a step of pre-shearing a carbon nanotube dispersion through sonication, as recited in Claims 54-55, 57-58, and 60-61.

It would have been obvious to one of ordinary skill in the art to include in the method of Bonsignore in view of Withers a pre-shearing to obtain a more uniform mixture, as taught by Tennant.

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22. Claim 50 is rejected under 35 U.S.C. 103(a) as being unpatentable over Bonsignore in view of Hoke (U.S. Pat. No. 4,209,408).

The discussion of Bonsignore in paragraph 12 above is incorporated here by reference. Bonsignore does not disclose a demulsifier in his fluid composition. Hoke, in lines 4-6 of the abstract, teaches the use of nitriles as demulsifiers in functional fluids.

It would have been obvious to one of ordinary skill in the art to include in Bonsignore a demulsifier for the purpose of preventing water-in-oil emulsions, as taught in column 1 lines 57-64 of Hoke.

Conclusion

23. The prior art made of record and not relied upon is considered pertinent to applicant's disclosure:

http://www.chevron.com/products/prodserv/BaseOils/grp2_typical.shtml and http://www.chevron.com/products/prodserv/BaseOils/grp3_typical.shtml show typical properties of Group II and Group III oils.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to James Goloboy whose telephone number is 571-272-2476. The examiner can normally be reached on M-F 8-4:30.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Vasu Jagannathan can be reached on 571-272-1119. The fax phone

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number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

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